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FARMERS' BULLETIN No. 217.

ESSENTIAL STEPS IN SECURING AN EARLY CROP OF COTTON.

BY

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., February 13, 1905.

SIR: We have the honor to transmit herewith a paper entitled "Essential Steps in Securing an Early Crop of Cotton," by Col. R. J. Redding, director of the Georgia Experiment Station, at Experiment, Ga.

Colonel Redding has directed carefully planned and exhaustive experiments in cotton growing for many years, and the results of his experience will prove of great value throughout the South. The work which has been done by Colonel Redding is of particular interest at this time in view of the gradual extension of the boll weevil into the more eastern portions of the cotton-growing area, since protection from great weevil damage largely depends upon the production of an early crop. We therefore recommend the publication of this paper as a Farmers' Bulletin.

Respectfully,

B. T. GALLOWAY,
Chief Bureau of Plant Industry.
L. O. HOWARD,
Chief Bureau of Entomology.

Hon. JAMES WILSON,
Secretary of Agriculture.

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ESSENTIAL STEPS IN SECURING AN EARLY CROP OF COTTON.

INTRODUCTORY.

In Farmers' Bulletin No. 189 of the United States Department of Agriculture, issued in 1904, it was stated that "The work of the Division of Entomology for several years has demonstrated that there is not even a remote probability that the boll weevil will ever be exterminated," and "The steady extension of the territory affected by the weevil from year to year, until the northern boundary is far north of the center of the cotton production in the United States, has convinced all observers that it will eventually be distributed all over the cotton belt. In ten years it has gradually advanced a distance of about 500 miles, and will undoubtedly invade new territory at about the same rate. It is not at all likely that legal restriction of any kind would prevent or materially hinder this spread."

These conclusions must be accepted as of the highest authority, since they have been reached by qualified scientific investigators after careful laboratory and field experiments, conducted for several years and on a large scale in the older weevil-infested region of Texas. The matter therefore is not a local problem, confined to Texas and nearby States, but affects the entire cotton-growing region. At the indicated rate of migration it is very probable that within ten or fifteen years every portion of the cotton-producing region will have been invaded. It is well therefore for the cotton growers northward and eastward of Texas to prepare for the worst by learning the methods that have been found effective in minifying the ravages of the weevil and such other remedies or palliatives as may be developed meantime, and be prepared to apply them whenever it shall become necessary. In view of the immense importance and value of the cotton crop the subject has indeed become of national, if not international, importance.

The bulletin mentioned, however, gives assurance that "although the very large yields of cotton of former times may no longer be possible, it is nevertheless entirely feasible to produce cotton at a margin of profit that will compare favorably with that involved in the produc-

tion of most of the staple crops of the United States by following what has become generally known as the 'cultural methods.'" Among the most important of these methods are those directed toward securing an early development of the cotton plants and an early maturity of the largest possible proportion of the crop, and the object of this bulletin is to discuss the practical details which have been found necessary and effective in promoting early maturity.

The writer may be pardoned for stating that most of what appears in the following pages is directly based on a long personal experience as a practical cotton grower and the superadded results of fifteen consecutive years of field experimentation at the Georgia Experiment Station. It was partly the purpose of many of these field experiments to discover the conditions of fertilizing and culture that were effective in promoting early maturity of the crop and the particular varieties best suited for securing such early maturity. It may be well to state that during the whole of the fifteen year period the work has been supervised by the writer, as director of the station, and the practical details have been superintended continuously by Mr. James M. Kimbrough, the agriculturist of the station.

THE SPECIFIC STEPS TO SECURE EARLY MATURITY.

THE PREPARATION OF THE SOIL.

The steps necessary to secure early maturity will be discussed in the natural order of cultural succession, rather than in the order of their importance and effectiveness in producing the desired result.

Little need be said in regard to the character, quality, and location of soil best adapted to the production of an early crop of cotton, since on every well-managed farm a regular system of rotation of crops should be practiced, which would successively bring into cotton culture most, if not all, of the soils of a given farm. It may be stated, however, that the naturally well-drained hills and uplands of the cotton belt are better adapted for the purpose than the level prairies, and that the soils of the latter are better than the alluvial bottoms of the rivers and larger streams.

Plowing.—The first attention should be given to such preparation of the soil as will enable the farmer to plant the cotton seeds at the earliest practicable date. To this end it is desirable that the first breaking, whenever practicable, should be done in the early autumn. In a district already seriously infested with boll weevils, and where cotton is to follow cotton, a two-horse middle breaker may be used to plow up the rows of stalks, and these stalks may be raked into windrows immediately and burned. Where the land to be prepared has just made a crop of corn or small grain the plowing may be in rather narrow "lands," using a two-horse turn plow or other preferred imple-

ment, running the lands whenever practicable at right angles to the intended direction of the rows of the following cotton crop and opening well the dead or finishing furrow of each land. These well-opened finishing furrows can result in little harm under any ordinary conditions, and will serve a valuable purpose in quickly draining the soil of superfluous moisture during a wet winter and early spring season, which might otherwise delay the final preparation and subsequent planting.

Final preparation of the soil.—The final preparation of the soil, which should be finished at least a week before the date of planting, consists in opening furrows and depositing fertilizers (when fertilizers are used), in throwing up with a turn plow or disk plow a well-formed bed, and in opening up a well-defined water furrow between the beds. The object of the beds and the water furrow is to secure the prompt removal, especially during a wet season, of surface water from the immediate soil that is to receive the seeds. It may often occur that planting may proceed along the middle of such beds when, if the soil had been broken flush, it would be impracticable to plant or even to stir the soil in any manner or for any purpose. The open water furrows serve the purpose of relieving the immediate seed bed of excessive moisture after the crop has been planted and during the early stages of growth of the delicate plants. In close, tenacious, moisture-retentive soils this detail of preparation is especially important. It is also particularly demanded on low-lying, naturally moist soils, such as are found near water courses and bayous.

Depth of plowing.—The depth of the preparatory plowing may not be indicated except by a general rule, varying in its application to different soils according to their character and depth. It should be of such depth and thoroughness as will secure a mellow, permeable seed bed of 6 to 10 inches in depth. On a very thin soil, with a poor and tenacious subsoil a few inches beneath the surface, the plowing should be deepened each year as the increasing store of humus (decayed vegetable matter) warrants. Subsoiling has not often been found to pay for the extra expense, in comparison with deep turning and thorough pulverization, aided by the harrow.

Harrowing.—The seed beds should be harrowed lengthwise once or twice, if necessary, to secure a fine, mellow, moist surface for the reception of the seed, the last time just ahead of the planting machine.

FERTILIZERS.

Character.—As a general rule, the composition and character of the fertilizers should be adapted to the particular demands of the plant to be grown, rather than the exigencies of the soil, especially when quite liberal applications are to be made. But when early maturity of the crop is especially desired these artificial helps, at least in part,

should be of a quickly soluble character so that the plant food will be available to the plants during the first few days of their growth. For general purposes a fertilizer containing about three parts of available phosphoric acid to one each of nitrogen and potash has been found very satisfactory in the worn uplands of the eastern Gulf and South Atlantic States, where the largest quantity of fertilizers is used. But when early maturity is desired an excessive amount of nitrogen should be carefully avoided, especially if the nitrogen is in organic form, such as cotton seed, cotton-seed meal, dried blood, etc., these materials supplying available nitrogen but gradually, and continuing to a later period of the crop, thus inducing a later growth and later maturity.

Application of fertilizer.—Acid phosphates and potash salts should be deposited in the soil and covered in by bedding from one to three weeks before the date of planting. If cotton-seed meal or dried blood or stable manure be relied on for the requisite supply of nitrogen, these should also be applied and well incorporated in the soil of the furrows on which the beds are to be formed. It would be better to apply the stable manure a month or more before the date of planting. Carefully conducted, repeated experiments have shown that the broadcasting of commercial fertilizers for a crop of cotton is not nearly so effective and profitable as is their concentration and thorough mixing with the soil underneath the rows of plants. In applying very large quantities of fertilizers to cotton, it is admissible to divide the same between the bedding furrow and one or both of the listing furrows. In one of the experiments conducted at the Georgia station a broadcast application of 1,000 pounds of a well-balanced fertilizer actually resulted in a smaller increased yield of cotton than followed the application of 500 pounds "in the drill," as just described. It is also highly probable that a broadcast application of fertilizer tends directly to produce later rather than early maturity.

Fertilizer for prairie soils.—On rich alluvial and prairie soils—capable of producing three-fourths bale to 1½ bales per acre without the aid of fertilizers—nitrogenous manures and fertilizers should be sparingly applied, or only as will be indicated under the head of "Planting," as such soils are naturally inclined to produce a large and luxuriant "weed" and a late crop of bolls, and this tendency would be promoted by their free use. The small amount of nitrogenous fertilizer that is admissible on such soils and advisable on all others should be so applied that the young plants may utilize it just as soon as their tiny rootlets shall have put forth and commenced their search for plant food. The nitrogenous ingredient advised for this purpose and the method of applying the same will be given under the head of "Application of fertilizer with seed," page 10.

Proportion of elements in fertilizer.—As already stated, the most effective proportion of the three so-called valuable elements has been found to be about three and one-third parts of available phosphoric acid, one part of nitrogen, and one part of potash. This proportion would be maintained in either of the following formulas:[a] 10 to 3 to 3; or 9 to 2.70 to 2.70; or 8 to 2.40 to 2.40; or 7 to 2.10 to 2.10, etc. The so-called "standard" cotton fertilizer, the 8 to 2 to 2 guano, is but a little deficient in nitrogen and potash, being relatively the same as 10 to 2½ to 2½.

On highly improved soils and on such as are naturally very fertile, as our dark alluvial black soils and "new grounds," the most effective single element of plant food is phosphoric acid. In many cases this is the only fertilizer that should be applied, and it should be employed in the form of an acid phosphate. The direct effect of phosphoric acid is to induce the formation of squares and bolls rather than "weed." Experiments at the Georgia Experiment Station and at other stations clearly indicate this, thus confirming the popular belief.

SELECTING THE VARIETY AND PLANTING.

Selecting.—In the effort to secure early maturity of the crop there is no more important factor than the selection of an early variety of cotton. The opinion prevails to some extent that there is "no great difference" in the matter of earliness between the several varieties grown in the country, and that quick maturity is dependent more on conditions beyond the control of the farmer than on good judgment in the selection of a variety whose habit is to bloom early, mature quickly, and open its bolls rapidly. This would be a much more serious mistake if such opinions were generally entertained, and it is fortunate that little need be said on this point. But it may be true that even those who recognize the importance of choosing an early variety do not fully realize its significance.

Variety tests.—At the Georgia Experiment Station a "variety test" of cotton has been carefully conducted in each of the last fifteen years. Among several points of merit, that of early maturity has had a prominent place in these tests, and it is fortunate that this work has been so long and so continuously conducted under the direction of the same officers.

[a] In stating a fertilizer formula in this bulletin the three usual "valuable elements" will be stated, without naming, in this order: Available phosphoric acid—nitrogen—potash.

TABLE 1.—*Showing the actual and comparative yields per acre of certain early varieties of cotton and the average yields of all the varieties tested for fifteen years (1890–1904).*

[Compiled from bulletins of the Georgia Experiment Station.]

Year.	Date of planting.	Number of varieties.	Early varieties and averages of all.	Yield per acre, pounds of seed cotton.					
				First picking.		Second picking.		Both pickings.	Total crop.
				Date.	Pounds.	Date.	Pounds.		
1890	Apr. 21	23	King	Sept. 9	583	Sept. 22	985	1,568	2,021
			Jenkins Gold Dust		523		606	1,129	1,545
			Average of 26 varieties		**166**		**786**	**952**	**1,695**
1891	Apr. 22	17	King	Sept. 7	187	Sept. 20	568	755	1,234
			Jenkins Gold Dust		219		560	779	1,249
			Average of 17 varieties		**80**		**400**	**480**	**1,290**
1892	Apr. 18	25	Truitt	Sept. 9	494	Sept. 28	589	1,083	1,621
			King		572		468	1,042	1,313
			Jenkins Gold Dust		624		442	1,066	1,378
			Average of 25 varieties		**343**		**566**	**909**	**1,390**
1893	Apr. 21	14	King	Sept. 5	236	Sept. 26	966	1,202	1,784
			Average of 14 varieties		**70**		**700**	**770**	**1,922**
1894	Apr. 17	15	King	Sept. 20	517	Oct. 3	550	1,067	1,881
			Average of 15 varieties		**147**		**455**	**602**	**1,685**
1895	Apr. 18	18	King	Sept. 17	335	Sept. 25	541	876	1,502
			Average of 18 varieties		**166**		**436**	**602**	**1,297**
1896	Apr. 14	20	King	Aug. 19	627	Aug. 31	703	1,330	1,721
			Average of 20 varieties		**302**		**636**	**938**	**1,714**
1897	Apr. 20	21	Mascot[a]	Sept. 3	926	Sept. 14	350	1,276	1,338
			King		787		430	1,217	1,304
			Average of 21 varieties		**478**		**635**	**1,113**	**1,333**
1898	Apr. 18	30	Mascot[a]	Sept. 7	1,145	Sept. 20	567	1,712	1,903
			King		998		500	1,498	1,651
			Texas Bur		940		849	1,789	2,014
			Average of 30 varieties		**745**		**865**	**1,610**	**1,917**
1899	Apr. 24	25	Shine	Aug. 21	291	Sept. 4	525	816	1,243
			King		330		477	807	1,153
			Mascot[a]		229		506	735	1,184
			Average of 25 varieties		**130**		**416**	**546**	**1,173**
1900	Apr. 27	21	*Average of 21 varieties*	Sept. 10	**318**	Sept. 19	**410**	**728**	**1,524**
1901	Apr. 24	26	Mascot[a]	Sept. 9	652	Oct. 3	686	1,338	1,432
			Roby		338		842	1,180	1,474
			Average of 26 varieties		**264**		**806**	**1,070**	**1,455**
1902	Apr. 22	26	Greer[a]	Aug. 20	507	Sept. 2	271	778	857
			Roby		316		362	678	894
			Average of 26 varieties		**253**		**385**	**638**	**922**
1903	Apr. 27	21	Greer[a]	Sept. 7	374	Sept. 22	474	848	1,385
			Cook's Improved		174		442	616	1,498
			Texas Bur		223		440	663	1,461
			Average of 21 varieties		**134**		**370**	**504**	**1,328**
1904	Apr. 18	24	Greer[a]	Sept. 2	411		580	991	1,310
			King		478		506	984	1,194
			Average of 24 varieties		**146**		**498**	**644**	**1,506**

[a] *Mascot* and *Greer* are selections from the original *King*, and each has proved equally early and at the same time more productive.

What Table 1 shows.—Table 1 has been compiled from the annual cotton culture bulletins and permanent records of that station. It is intended to show the comparative as well as absolute yields of seed cotton per acre of one or more distinctively early varieties, and the average yields of all the varieties tested in each year. The date of planting, the dates of the first and second pickings, the yield of each early variety, the average yield of all the varieties in each year's test at each of the first two pickings, and the total crop yield of each are given in the columns under proper headings. It is believed that the table will be easily understood by any reader.

In the column headed "Both pickings," the yields per acre of the first and second pickings are added together, thus showing the yield of each variety up to and including the second picking and permitting

a comparison of the yields at either of these two pickings, as well as the sum of the two. This is followed by the "Total yield" of the crop of each variety at the final picking. The number of pickings varied in different years from four to six, being usually five. It is believed that this exhibit of the yields at the first and second pickings is the most convenient and effective means of determining the relative earliness of the different varieties, and the method has been uniformly practiced at the Georgia station.

It will be noticed that no early variety was included in the test of 1900, owing to the fact that the grower of whom seeds of a standard early variety were ordered failed to deliver them in time.

As stated in the footnote to the table, Mascot and Greer are both selections from King, first brought to general attention as a very early variety by the published tests of the Georgia Experiment Station, commencing in 1891 and repeated annually, excepting four years. In the eleven years in which the King was tested it stood, in point of earliness: First, five times; second, five times; third, once. In point of productiveness: First, once; second, three times; third, once; fifth, once; thirteenth, once; eighteenth, twice; twenty-fourth, once, and twenty-seventh, once. The variety maintains its earliness as an apparently well-fixed quality, but has declined of late years in total productiveness, being excelled by two of its progeny—Greer and Mascot—the former improved by selection in north Alabama, and the latter in the same manner near Macon, Ga.

The main object of the exhibit in Table 1, however, was to show the supreme importance of selecting an early type when the object is to secure a large early harvest.

Planting.—Of course the planting should be done as early as past experience in a given locality and on a given soil has shown to be reasonably safe. The suggestions in regard to preparation of the soil included some details intended to facilitate planting immediately when the right time arrives. The day of the month and the proper condition of the soil as to moisture should control and determine when to plant rather than the temperature of the air, the direction of the wind, or the appearance of certain wild flowers. "Plant when the soil has been properly prepared and is in good workable condition, and when the proper date has arrived" is a good rule.

Just ahead of the planting machine the beds should be harrowed or boarded off, so as to leave a smooth, fresh, moist surface. This may be rapidly and effectively done with a heavy board on edge, extending across two rows and drawn by one mule by means of shafts attached. Let the seed fall in a fresh, mellow, moist bed and be immediately covered from 1 to 1½ inches in depth. In droughty soils or sections it is often important to compact the soil over and around the seeds in

order to secure prompt germination. If the soil is rather dry a more effective plan is to cover the seeds 2 to 4 inches deep with a slight ridge, and scrape this ridge off within a few days or a week.

Application of fertilizer with seed.—At the time of planting it has been found an excellent practice to apply a few pounds of readily soluble fertilizer directly in the furrows with the seed. For this purpose a portion of the fertilizer intended to be bedded on may be reserved (say 40 to 50 pounds per acre); but nitrate of soda has been found most convenient and effective and it should be applied at the rate of 25 to 40 pounds per acre. The effect of this small dose of quickly soluble and immediately available nitrogen is to cause the young seedlings to be very strong and vigorous on their first appearance, and to grow more luxuriantly during the first few weeks after planting, enabling the farmer to commence the work of cultivating and thinning to a stand some days earlier and with more confidence. The experience of a good many years justifies a strong indorsement and recommendation of this simple detail. The nitrate of soda may be applied by strewing it along behind the planting machine either immediately or within a day or two. No covering is necessary.

A crop so reenforced and encouraged at the very start will be more likely to escape injury from plant lice, cutworms, and the like, and the more vigorous young plants will be able to resist the effects of rough or careless working. In the early history of the use of commercial fertilizers (mostly imported guanos), it was a favorite expedient of the writer to "roll" his planting seed in Peruvian guano, first thoroughly wetting the seed and using the fine, dry guano as a "drier." For this purpose 6 pounds were found to be ample for 1 bushel of seed. Not the slightest injury to the seed ever resulted from the practice; but the dark green, vigorous appearance of the plantlets was most remarkable. It was a good practice, resulting in great saving of planting seed—a desideratum when seeds of a desirable variety are scarce and high priced—as well as in securing a good stand of vigorous, healthy plants.

A simple, easily constructed machine for "rolling" the seed may be made in an hour by any carpenter: Take an ordinary iron-bound whisky barrel. From the middle of one side, saw out a square hole extending across two or three of the staves, or, say, 10 or 12 inches square. Batten together the pieces sawn out so as to form a shutter for the opening, and fasten with thumb buttons. Run a 2 by 2 inch wooden axle through the center of the heads, with a common winch at one end; mount the barrel like a grindstone, on two posts set in the earth. To operate it, put in 2 bushels of cotton seed and an ordinary pailful of water. Turn the barrel slowly back and forth a few minutes until every seed is wet. Let the superfluous water drain

away for a half minute. Then add about 12 pounds of any suitable fine, dry powder, such as Peruvian guano, land plaster, slaked lime, road dust, or sweepings from beneath a house. Turn the barrel back and forth slowly a few times and the seed will be found ready to plant, "every one to itself."

SPACING THE PLANTS.

The proper width of row was not considered under the head of preparing the land, at which time such width is usually determined, because it may be more properly discussed in connection with the spacing of the plants in the rows. The width of row and distance between plants in the rows are complements; as one increases, the other decreases.

Repeated experiments, both in corn and cotton culture, conducted under the writer's direction, have resulted in proving most conclusively that the nearer the plants are placed on a square, the greater will be the yield of crop. If an area of 12 square feet is to be assigned to each plant, it were better—certainly they would prove more productive—to space them 4 by 3 feet or 3 feet 5½ inches by 3 feet 5½ inches than to space them 6 by 2 feet or 8 by 1½ feet.

Assuming the proposition as admitted, the greater cost of cultivating narrow rows is also admitted, and it remains for each farmer to determine for himself, after careful experiment, whether the greater yield of the narrow rows will be sufficient to justify the increased expense. In the experience of the writer, cotton planted in 3-foot rows and spaced to one plant every 2 feet, or 3 by 2 feet, has invariably produced an excess more than sufficient to pay for the greater expense of planting and cultivating in comparison with cotton planted 4 by 1½ feet, or 5 by 1.2 feet, or 6 by 1 foot, the area to each plant being 6 square feet in each case.

W. D. Hunter, in Farmers' Bulletin No. 189, however, strongly urges the importance of placing the "rows as far apart as experience with the land indicates is feasible, and thinning out the plants in the rows thoroughly." How far the Texas cotton grower should widen his rows and thin out the plants in the rows, as a means of lessening the prospective or next year's crop of boll weevils by permitting a freer access of sunlight and heat at the cost of a certain loss in the present year's crop of cotton, the writer is not prepared (nor is he called upon) to determine. It should be settled by those who are on the "firing line."

Number of plants to the acre.—The number of plants to the acre is a very vital detail in planning to secure a large and certain early yield of crop, and is itself an independent question. At the Georgia Experiment Station it has been shown by repeated field experiments that on

the soils of the station farm, which are capable of producing, with liberal fertilizing, 1 to 1½ bales per acre, when spaced 4 by 1 foot the yield per acre at the first and second pickings has almost invariably exceeded the yields when spaced 4 by 2 feet, and without exception when spaced 4 by 3 and 4 by 4 feet, these spacings requiring, respectively, 10,890, 5,442, 3,630, and 2,722 plants per acre.

For the purpose of more clearly illustrating the proposition, the results in detail of two of these experiments out of a number that might be cited are given in Table 2. The first experiment was made in 1891, and covered 1 acre of land. It so happened that the gathering season was prolonged to a later date than usual, involving six pickings in order to harvest the entire crop. The second experiment was made in 1892, also covering 1 acre of land, and the crop was harvested in four pickings. In each experiment there were four series of four plats, each plat consisting of four 4-foot rows. The table gives the mean or average results of the four plats in each of the four series.

TABLE 2.—*Two experiments in spacing cotton.*

FIRST EXPERIMENT—1891.

How plants were spaced and number per acre.	Actual number plants maintained per acre.	Yields in pounds of seed cotton per acre at each picking and average yield per plant.													
		First picking, Sept. 8.	Yield per plant.	Second picking, Sept. 22.	Yield per plant.	Third picking, Oct. 1.	Yield per plant.	Fourth picking, Oct. 16.	Yield per plant.	Fifth picking, Nov. 4.	Yield per plant.	Sixth picking, Dec. 2.	Yield per plant.	Total yield per acre.	Average yield per plant.
4 by 1 ..... 10,890	9,250	93	0.010	611	0.066	609	0.065	342	0.037	212	0.023	76	0.008	1,943	0.210
4 by 2 ..... 5,442	5,005	22	.004	401	.080	637	.127	444	.089	383	.076	140	.028	2,027	.405
4 by 3 ..... 3,630	3,549	25	.007	324	.090	585	.165	461	.130	452	.127	160	.045	2,007	.565
4 by 4 ..... 2,722	2,665	13	.005	243	.090	485	.182	444	.166	505	.190	143	.053	1,833	.687

SECOND EXPERIMENT—1892 (FOUR PICKINGS ONLY).

How plants were spaced and number per acre.	Actual number plants maintained per acre.	Yields in pounds of seed cotton per acre at each picking and average yield per plant.									
		First picking, Sept. 16.	Yield per plant.	Second picking, Sept. 29.	Yield per plant.	Third picking, Oct. 17.	Yield per plant.	Fourth picking, Nov. 21.	Yield per plant.	Total yield per acre.	Average yield per plant.
4 by 1 ..... 10,890	9,559	593	0.062	554	0.058	384	0.040	85	0.009	1,616	0.169
4 by 2 ..... 5,442	5,278	449	.085	556	.105	398	.074	113	.021	1,516	.285
4 by 3 ..... 3,630	3,545	323	.091	514	.145	472	.133	192	.054	1,501	.423
4 by 4 ..... 2,722	2,652	221	.083	432	.163	487	.183	299	.113	1,439	.542

A careful examination will quite conclusively show that in both experiments the closer planting resulted in much larger yields of seed cotton. Read the numbers in columns 3 and 5, which represent the yields per acre at the first and second pickings, respectively, and note how regularly (with two exceptions) these numbers decrease from the top to the bottom of each half of the table. Note, also, in column 4 that the yield per plant of 9,250 plants, 4 feet by 1 foot, is exactly twice the yield per plant of 2,665 plants in the 4 by 4 foot series. This abnormal tendency, however, does not appear in the same column of the second experiment, in which all the progressions, ascending and descending, are remarkably regular.

It requires but a moment to discover that the yields per acre of the closer-spaced series, up to and including the second pickings, were very much ahead of the yields of the wider-spaced series. At the same time the 4 by 2 foot series in the first experiment, and the 4 by 1 foot series in the second experiment lead the others very decidedly in the total yield, as shown in column 15.

As already intimated, the results of these two experiments are fully sustained by those of a number of similar experiments in following years, and it seems impossible to avoid the conclusion that on soils of the character represented by those of the Georgia station close spacing—or, as farmers express it, "crowding" the plants—within the limits tested results in a larger early harvest and also in a greater total yield.

There are limitations and modifications in the practical application of the teachings of these experiments. It is not to be supposed for a moment that such close planting as 4 feet by 1 foot, or even 4 by 2 feet, would be effective or expedient on the moist, rich, alluvial soils of the Mississippi Delta or the Brazos River, or on any soils on which the cotton plants reach a height of 6 to 8 feet with a corresponding horizontal development.[a]

But the principle involved is doubtless applicable everywhere and on all soils. It remains for those who cultivate a particular soil, or who manage the experiment station of a State in which such soils abound, to find out by direct field experiments the "best distance" for cotton. It will probably be found, as a rule, that too great distance is given, this being especially true on old, worn uplands, and that the practice results every year in the loss of many hundreds of thousands of bales of possible production in the South as a whole.

[a] The writer may be permitted to suggest that such soils are not ideal cotton soils, but should rather be devoted to corn, oats, sugar cane, meadow, etc.

CULTIVATING THE CROP.

Cultivation should commence as soon as the plants "are up," and it is often expedient to run a smoothing harrow over the field even before the plants have commenced to appear. This is especially indicated when a heavy shower of rain falls on the land after planting, the object being twofold—to stir the top soil and prevent the formation of a "crust" and to destroy the germinating weeds before they appear. Incidentally such stirring conserves moisture by retarding the ascent and evaporation of water from beneath the surface of the soil. Indeed, the frequent stirring of the surface of the field to the depth of from 1 to 2 or 3 inches is practically all that is meant by "cultivating the crop," so far as it may be accomplished by horsepower and expanding implements.

If the surface be not stirred as suggested immediately before the plants come up, it should be done as soon as possible thereafter, and the operation may often be repeated to advantage two or three times at intervals of a week or ten days.

The best implement for horsepower tillage is one that will "clean out" a row, i. e., stir the surface soil from row to row, as nearly as possible at one time. On the rolling lands of the older cotton States a good expanding one-horse cultivator, capable of sweeping out a 3½ to 4 foot row at one time, is much in favor. On larger areas, level lands, and heavier soil a two-horse cultivator is to be preferred.

Hand cultivation.—So soon as the cotton plants have commenced to show the third leaf and are in healthy condition the hand hoe should be put to work. The rows of plants should be "blocked out" at a rapid gait, using a new hoe of such width of blade that one or two strokes will leave a bunch of two to four plants at the predetermined distance at which the final plants shall stand. The hands engaged in this work should go in a half walk, not striking twice in the same place. On smooth, clean land and with a good stand an active man may with ease block out 2 acres a day in 3-foot rows, and more in proportion if the rows are wider.

The object in view in going over the crop so rapidly is to destroy the surplus plants, and incidentally some grass, as rapidly as possible. The immediate object should be to individualize the plants that are to remain at as early a date as possible, to throw upon them—so to speak—the responsibilities of the position at once, that they may adapt themselves to the surroundings and develop rapidly and vigorously. On comparatively level, well-prepared land of high productive quality, on which the spacing should not be less than 2 or 3 feet between the plants, there is no reason why this preliminary blocking out may not be done by cross-plowing the rows with a flat sweep or other suitable plowshare. It would seem also practicable to use a planting machine

that will drop a number of seeds at proper intervals instead of depositing them in a continuous row, as almost universally practiced. Such planters are in use to a limited extent in some sections.

To sum up this first stage of cultivation: The cotton plants should be thinned to the final stand as quickly as possible, and all efforts should tend to that end. After the plants have been thinned to such final stand cultivation should be mainly shallow and often repeated, the immediate object being to prevent evaporation of soil moisture by keeping the surface as nearly as possible always broken and mellow. "Once a week and once to the row," with a good horse cultivator, is an excellent rule.

Cultivation after flowers appear.—This rapid cultivation encourages a vigorous and healthy growth of the plants, and should be continued up to about the time the blossoms begin to appear freely and the plants shall have commenced to put on "fruit." These early blooms—those that appear during the third month after planting—are to produce the early bolls and yield the early pickings of cotton. If the soil be stirred at all during the early period of rapid blooming, the work should be done very carefully, the cultivators running very shallow. What is now wanted is rapid blooming, not fast growing, and the certain retention and development of the bolls. Injudicious cultivation at this period, especially if at all deep, tends to encourage "weed" development and loss of young fruit ("shedding"). Late cultivation tends to large growth of "weed" and a late crop of cotton, and may be in order when the main object is to secure the largest possible total yield, regardless of earliness.

Shedding.—Every farmer has noticed the great increase in shedding which often occurs within a few days after a heavy rain in July followed by hot, sunny weather. Many careless observers think the "forms" thus thrown off have not yet quite reached the bloom. In this notion they are in error, since it is a fact that a very great majority of the supposed forms that have been dropped are young bolls only a few days from the bloom. Many such young bolls doubtless drop because of a failure of pollination due to constant rain or damp weather. But such shedding of young bolls is often noticeable immediately following a rather deep cultivation, even when weather conditions are entirely favorable to pollination. Indeed, deep cultivation in July is sometimes resorted to by skillful farmers in order to encourage a further and larger development of the plant. The removal of every boll and form from selected plants as late as July 4 has been known to result in an immediate resumption of growth and a larger yield of cotton from the plants thus treated than from adjacent plants that were not so treated. So, it seems, a loss of forms and immature bolls by actual manual removal may induce and promote

renewed growth of the plant; and, conversely, the renewed growth, when induced by abundant rainfall and sunshine, or by deep cultivation, causes the shedding of undeveloped fruit.

Results of cultivation.—It may be consistently stated, as a general rule, that early, frequent, and shallow cultivation tends to produce and mature a crop of early bolls; deeper and later continued cultivation tends rather to delay and hinder the development of the early bolls, but may increase the final and total yield of the crop in sections where the weevil does not occur.

CLEARING AWAY THE PLANTS IN THE AUTUMN.

The authority already quoted recommends the total uprooting and destruction by burning of the entire plants at an early date in the fall, with the view of destroying as many as possible of the weevils then existing in the several stages of development. Reference has already been made to the use of a two-horse "middle-burster," of which several kinds are manufactured. This implement will lift out the stalks entire, including the main root and large surface laterals. After a few days' sunning the plants may be gathered by means of a horse rake into large heaps or into windrows and destroyed by burning. The use of cheap petroleum sprayed over the piles of stalks greatly assists in destroying them, rendering it unnecessary to wait until they become sufficiently dry to burn alone.

SUMMARY.

(1) Prepare the soil thoroughly and early, beginning with fall plowing.

(2) Fertilize liberally and judiciously, carefully avoiding an excess of nitrogen. On rich, dark, alluvial, and freshly cleared soils, phosphoric acid alone, in the form of acid phosphate, may be applied.

(3) Apply fertilizers in the drill and bed on them. Broadcasting is rarely, if ever, expedient.

(4) Choose an early maturing and productive variety of cotton, and plant on the beds, and as early as possible. Apply in the seed furrows 40 to 75 pounds per acre of quickly available fertilizer, preferably 25 to 40 pounds of nitrate of soda.

(5) Reduce to a final stand as quickly as possible.

(6) Let cultivation be frequent and shallow.

(7) Narrow rows with wide spacing of plants in the rows will result in a greater early yield than will wide rows with close spacing.

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